Quantum Numbers – Worksheet 2

1. For each value of *l*, identify the orbital name (*s*, *p*, *d*, *f*, etc), the shape, and the possible values of m_l.

	Orbital Name	Shape	Possible values of m_l
$l = 0$	*s*	Sphere	0
$l = 1$	*p*	Dumbbell	-1,0,1
$l = 2$	*d*	Four-leaf clover	-2, -1, 0,1, 2
$l = 3$	*f*	Complex	-3, -2, -1, 0, 1, 2 3

2. Provide the all the possible values for the other three quantum numbers for electrons in:

a. $n = 2$

	Possible Values	
l	0	1
m_l	0	-1,0,1
m_s	+1/2,-1/2	+1/2, -1/2

b. $n = 3$

	Possible Values		
l	0	1	2
m_l	0	-1,0,1	-2,-1,0,1,2
m_s	+1/2 -1/2	+1/2 -1/2	+1/2 -1/2

3. Which of the following represents a permissible set of quantum numbers? (answer "yes" if permissible and "no" if not permissible)

	n	*l*	m_l	m_s	Permissible? (If not, why?)
a.	2	2	1	-1/2	Not permissible: *l* cannot be 2, it can only be 0 or 1.
b.	5	1	0	+1/2	Permissible
c.	6	3	-2	+1/2	Permissible
d.	7	0	0	-1/2	Permissible
e.	4	1	3	+1/2	Not permissible (The possible m_l values here are -1,0,1)
f.	1	1	0	+1/2	Not permissible (*l* values are from 0 to (*n*-1), so $l = 0$ here.
g.	2	3	-2	-1/2	Not permissible, since values of *l* range from 0 to 1.

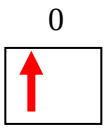
4. How many electrons in an atom can have the quantum numbers starting with:

a. $n = 4$, $l = 3$ (Since $l = 3$, we are talking about d orbitals. Since there are 5 d orbitals, there can be up to 5x2 = 10 electrons).
b. $n = 2$, $l = 1$, $m_l = -1$. (There are 2 electrons maximum in every orbital).

d. $n = 3$, $l = 2$ (There are five d orbitals, therefore 2x5 = 10 electrons)
e. $n = 3$ There can be up to $2x(3)^2 = 18$ electrons (note that at level n there can be up to $2n^2$ possible electrons)

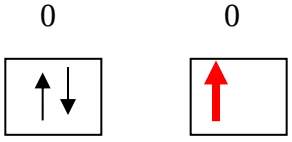
5. Write the values for the quantum numbers for the **bold** electron(s) in the following orbital diagrams (note that the orbital name and the possible m_l values are provided).

a.



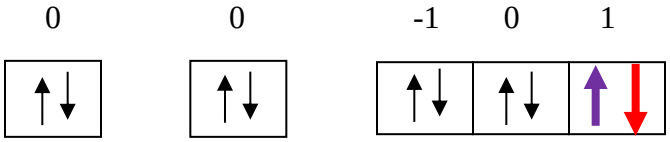
$n = 1$, $l = 0$, $m_l = 0$, $m_s = +1/2$.

b.



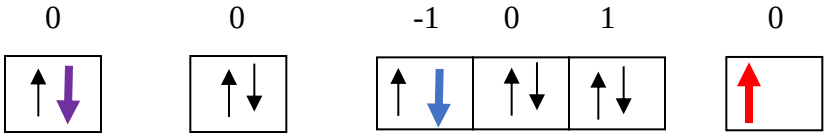
$n = 2$, $l = 0$, $m_l = 0$, $m_s = +1/2$.

c.



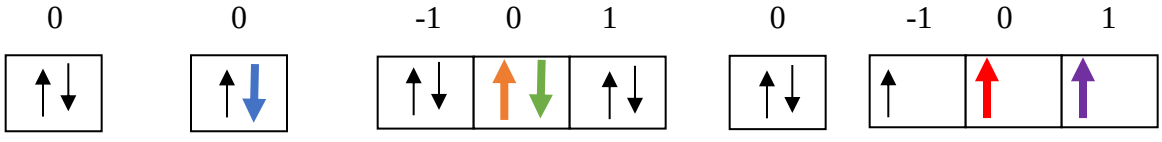
$n = 2$, $l = 1$, $m_l = 1$, $m_s = +1/2$.
$n = 2$, $l = 1$, $m_l = 1$, $m_s = -1/2$

d.



$n = 1$, $l = 0$, $m_l = 0$, $m_s = -1/2$
$n = 2$, $l = 1$, $m_l = -1$, $m_s = -1/2$
$n = 3$, $l = 0$, $m_l = 0$, $m_s = +1/2$

e.



$n = 2$, $l = 0$, $m_l = 0$, $m_s = -1/2$
$n = 2$, $l = 1$, $m_l = 0$, $m_s = +1/2$
$n = 2$, $l = 1$, $m_l = 0$, $m_s = -1/2$

$n = 3$, $l = 1$, $m_l = 0$, $m_s = +1/2$
$n = 3$, $l = 1$, $m_l = 1$, $m_s = +1/2$